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(54) METHOD OF FERROELASTIC RECORDING

(71) We, NORTH AMERICAN PHILIPS CORPORATION, of 345 Scarborough Road, Briacliff Manor, New York 10510, a Corporation existing under the State of Delaware, United States of America do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method of information storage and retrieval in ferroelastic metals.

A ferroelastic material is one that exhibits:

1. a stable remanent strain in the ferroelastic state with respect to the paraelastic state above the ferroelastic Curie temperature;

2. a paraelastic state where there is no stable remanent strain;

3. a ferroelastic Curie temperature at which a reversible thermoelastic (low temperature hysteresis) martensitic (diffusionless) transition occurs; and

4. a hysteresis in its stress-strain characteristics, and an anomaly in one of the elastic constants at the Curie temperature;

Certain alloys undergoing martensitic phase transitions but whose ferroelastic character has not yet been ascertained, have been shown to have useful shape memory properties.

U.S. Patent 3,558,369 describes metal alloys of the formula

$$TiNi_xCo_{1-x}$$

and

$$TiCo_xFe_{1-x},$$

wherein x is a number from 0 to 1, which are prestressed and then heated to cause them to revert to their original state. Such alloys are stated to be useful on control devices.

U.S. Patent 3,450,372 describes a foldable antenna for a spacecraft vehicle which is unfolded by heat radiation. Such antennae are made of a nickel-titanium alloy which reverts to its original state upon heating.

The invention provides a method of recording and retrieving information, the method comprising the steps of deforming the surface of a ferroelastic metal which undergoes a reversible elastic phase transition on heating to above a given transition temperature, locally heating portions of the ferroelastic metal above the given transition temperature so as to restore each said portion to its original undeformed state in response to an information signal and thereby recording the information signal as a surface relief pattern on the ferroelastic metal, and thereafter scanning the surface of the ferroelastic metal so as to detect variations in the surface relief of the pattern, and thereby retrieving said recorded information signal.

This technique can be used for recording and retrieving information in small areas (10^{-4} to 10^{-9} cm²).

In one embodiment of the invention, a thin film of such a ferroelastic metal which may be prepared by conventional rolling, sputtering or other established metallurgical processes, e.g. on a metal disc or on an elongated strip, and which undergoes a ferroelastic phase transition, is initially prestrained in the ferroelastic phase to produce a remanent strain. For example, the ferroelastic metal may be prestrained by air jets, a stylus, or an electrostatic force of repulsion or attraction.

Once the metal film is prestrained, information is recorded on the ferroelastic metal by locally heating discrete portions above the ferroelastic Curie temperature, i.e. the metal alloy at those portions is relaxed so that it is free of remanent strain, a necessary condition in the paraelastic phase. Upon cooling from the paraelastic to the ferroelastic phase the metal will twin, i.e. will produce ferroelastic domains, and the macroscopic strain previously introduced will be relieved. This heating and cooling cycle may be most easily accomplished by a focussed laser beam controlled by an information signal which is to be recorded. Upon completion of the recording of the information signal, the in-